Bank Credit Policies And Sustainability: Comparative Analysis Between The Green Asset Ratio (GAR) And The Banking Book Taxonomy Alignment Ratio (BBTAR)

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Abstract:
This paper analyzes the role of sustainable finance in the banking sector, focusing on the comparative analysis of two key metrics: the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR). The GAR measures the percentage of banking assets aligned with the EU Taxonomy, while the BBTAR offers a broader view by including exposures to small and medium-sized enterprises (SMEs). The analysis highlights the strengths of the GAR in terms of regulatory compliance and comparability, while emphasizing its limitations in capturing the full spectrum of a bank's sustainability efforts. The BBTAR, on the other hand, provides a more comprehensive assessment, incorporating a wider range of taxonomy-aligned activities, including those of companies not belonging to the NFRD. To maximize the effectiveness of these metrics, a two-pronged approach is recommended, using the GAR for regulatory reporting and the BBTAR for internal assessments and strategic planning. It also highlights the importance of improving data collection and modeling capabilities to increase the accuracy and reliability of BBTAR calculations. The results highlight the need for a balanced approach that considers both regulatory requirements and the broader impact on the sustainability of banking activities. The paper contributes to the ongoing debate on the integration of ESG criteria into credit policies and on the role of the banking sector in the green transition. Overall, the analysis provides valuable insights for policymakers, regulators and financial institutions in their efforts to align credit policies with sustainability objectives.
Keyword: *Sustainable finance, EU taxonomy, Green Asset Ratio, Banking Book Taxonomy Alignment Ratio, Financial Sustainability Metrics*

I. Introduction

Since the formulation of sustainable development in the Brundtland Report (WED, 1987), the issue of sustainability and the transition to a low-carbon economy (COP 21) has been a central aspect of the European Union's economic policies.

This is confirmed by the most important approaches to the topic of sustainable development, such as the development of the United Nations 2030 Agenda and the adoption of the Paris Climate Protocol (ECB, 2022). These aspects are essential to guarantee competitiveness and long-term economic development, while preserving the needs of future generations.

The financial sector is assigned a leading role and is therefore required to integrate the requirements of regulatory authorities regarding the role of banks and markets in the transition to a quality-oriented green economy.

Strengthened regulation, therefore, offers a significant incentive for financial and non-financial companies (Smith et al., 2022) to implement sustainability strategies. Taking into account the significant impact of environmental, social and climate phenomena, European regulators have intervened in the banking and financial sector, with EU Directive 2014/95[1], which introduced non-financial disclosure rules for public-interest entities and in particular for banks, issuing companies and insurance companies. This led to the need to develop common rules that take into account the economic aspects linked to ESG factors in regulated markets, with the development of EU Regulation 2019/2088[2] on sustainable finance disclosure (SFDR) and EU Regulation

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[1] Directive no. 2014/95/EU, the so-called "Non-Financial Reporting Directive", which amended Directive no. 2013/34/EU on annual and consolidated financial statements, extending the obligation to report on social and environmental issues.
[2] EU Regulation no. 2019/2088 of November 27, 2019.

2020/852 on taxonomy[3]. Thanks to this approach, ESG criteria play a significant role in the central areas of banking and financial systems, contributing to the green transition and the achievement of sustainable development goals.

In the second paragraph of the document, starting from risk management, whose strategic importance in the banking sector is evident, risk management strategies are analyzed, interpreted as a set of tools designed to contain risk situations that could alter the probability of distribution of the future value of banking assets within financial institutions. The objective of this process is to implement a complete risk management system to increase the value of the bank, avoiding the occurrence of financial shocks with consequent negative effects.

Although climate and environmental changes offer significant opportunities, they also involve risks, especially in the financial sector, since every phenomenon capable of contributing to climate change affects credit and financial systems, exposing them to new types of risk that are no longer traditional for the banking sector, but specific, such as Climate-Related Financial Risks (CRFR). According to the statement published by the European Commission, the concept of 'sustainable' finance refers to an approach aimed at evaluating the environmental, social and governance (ESG) components in the investment decisions of the financial sector, encouraging long-term investments in sustainable economic activities and projects.

The EU taxonomy promotes a procedure for classifying financial investments as environmentally sustainable if they meet certain requirements and characteristics, defined in articles 6, 7 and 8 of the same Regulation[4], providing specific Key Performance Indicators (KPIs) through which information must be provided, in addition to the related calculation methods. These KPIs have been defined differently depending on whether they are aimed at financial companies, non-financial companies, financial asset managers, investment companies, banks or insurance companies.

The main criterion for analyzing the "green nature" of a company and/or financial institution is the Green Asset Ratio (GAR), which defines the percentage of exposure of banks that comply with the taxonomy in relation to a given share of total assets. According to academic literature, the GAR is an unreliable index of the 'greenness' of banking activities, as the ratio is calculated by excluding a large part of banking activities from the numerator, regardless of their carbon footprint. The main shortcomings are related to the following aspects: the exclusion of a significant number of companies (in particular SMEs), which has negative repercussions on interbank relations, given the greater exposure of banks to these categories of companies, which have a lower GAR; the exclusion from the numerator of all activities not included in the European Taxonomy that fall within the denominator; the difficulties for companies and households in providing documentation of compliance with the "no significant harm" (DNSH)[5], technical screening criteria (TSC) and minimum safeguard (EU, 2023/2486) principles imposed by art. 8 of the Taxonomy, with reference to banking activities. 8 of the Taxonomy with reference to carbon dioxide emissions. To overcome the limitations mentioned above, an additional parameter has been introduced, the Banking Book Taxonomy Alignment Ratio (BTAR), disclosed on a voluntary basis by banks, which also includes some categories of companies not covered by the CSRD.

The third part of the document is dedicated to a comparative analysis between the two main metrics, the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR), to assess their efficiency and limitations in the context of financial sustainability. In conclusion, the results will be presented, indicating the practical implications for the banking system and the possibilities for improvement to encourage the green transition.

The elements used for the analysis come from official sources and reference documents on banking sustainability and the European Taxonomy. In particular, reference was made to the reports published by the European Banking Authority (EBA), which offer detailed data on the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR). In addition, a series of aggregated data from industry studies (such as the annual report of the main Italian banks) was used, containing information on eligible and aligned assets. For loans secured by residential real estate, data was extracted from the market analysis and ESG reports of the

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[3] Regulation (EU) 2020/852 of the European Parliament and of the Council of June 18, 2020, on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

[4] The Taxonomy Regulation has been supplemented by Delegated Regulation (EU) no. 2021/2139 (the so-called "Climate Act"), which established the criteria for determining whether and under which conditions an economic activity contributes substantially to mitigating or adapting to climate change, and if it does not cause significant damage to any other environmental objective.

[5] Delegated acts, prepared with the advice of the Platform on Sustainable Finance, explain the conditions Suitable for establishing the conditions under which individual economic activities contribute to at least one of the six environmental objectives, without causing significant harm to any of the other five (the "Do No Significant Harm" - DNSH clause).

main Italian banks, which highlight the portfolio structure and degree of alignment. Finally, I integrated the data with simulations based on standardized metrics to ensure the consistency and representativeness of the results.

II.   Main European Policies On Sustainable Finance

Sustainable credit is an essential tool for the banking sector in the transition to a greener and more inclusive economy. The term sustainable credit refers to the disbursement of loans that respect ESG (environmental, social and governance) criteria, incentivizing economic activities that can mitigate climate change, protect the environment and strengthen social conditions (Scholtens, 2006). These criteria have taken on a central role for banks, as well as for ethical reasons, to govern the financial risk linked to climate change and the transformations of the global economy (Rudebusch, 2021). Looking at the most recent initiatives, particular attention should be paid to the establishment, in October 2016, of the High-Level Expert Group called upon to develop a European roadmap on sustainable finance (HLEG, 2016). Based on the final report of the Expert Group, the European Commission published the Action Plan for Sustainable Growth in March 2018 (EC, 2018), which highlights the "catastrophic and unpredictable" repercussions of climate change and resource depletion, reiterating the need to review the economic-productive system, while, on the other hand, the contribution of the financial sector is necessary to redirect private capital in favor of a more sustainable economy. In this sense, the Commission clarifies how sustainable finance consists of making investment decisions with due consideration for environmental and social factors, to obtain greater investments in long-term sustainable activities, underlining how these choices are "economically valid and do not necessarily produce a lower profit for investors". In 2021, the European Commission adopted the Sustainable Finance Strategy (EC, 2021), in which it defines the next steps to be taken to best support the transition to a more sustainable and resilient economy. Considering the limited public resources available in this regard, the Commission aims to direct private financial flows towards sustainable economic activities[6]. To this end, it identifies the inclusion of ESG risks in prudential regulation, financial reporting and credit assessments, as well as the fight against greenwashing. With regard to the financial system as a whole, the Sustainable Finance Strategy calls on stakeholders to systematically take into account the financial risks associated with sustainability ("outside-in") and the impact of financial activities on sustainability ("inside-out") in their decision-making processes, so that the financial sector is more resilient to ESG risks and contributes, at the same time, contribute to the success of the European Green Deal (Bevivino, 2022). To enable actors in the economic-financial system to make informed investment choices, including the level of sustainability of the products offered on the market, the legislation of Directive 2014/95/EU, the so-called Non-Financial Reporting Directive (NFRD), has been implemented. This introduces the obligation to publish a non-financial statement (NFS) at a European level for the main public interest companies[7]. Specifically, the directive introduced in 2014 requires the publication of information on environmental and social aspects, employees, the protection of human rights and the fight against corruption, "to the extent necessary to understand the company's development, performance, position and impact" (article 19-bis). In this regard, it should be emphasized that the NFRD provides for a "comply or explain" scheme, according to which companies that have not adopted sustainability policies will only have to provide in their NFS "a clear and detailed explanation of the reasons for this choice" (art. 19-bis, par. 1, co. 2), consequently there is no positive obligation in this sense (Rescigno, 2022). Non-financial reporting has been extremely flexible, as the specific methodologies and contents of the preparation have been defined in non-binding acts of the European Commission, with all the consequences that this entails in terms of reliability and comparability of the information provided by companies[8]. This aspect has proven to be in contradiction with the directive's objective of increasing the relevance, uniformity and comparability of the information communicated by some large companies and groups. The inadequacy of the NFRD is also aggravated by its subjective and restricted scope of application which, by limiting itself to large listed companies, has narrowed its field of application, prompting the legislator to completely reform the sector. Given the inadequacy of the NFRD framework, in 2022 the European Commission developed a framework capable of promoting flexibility and standardization in the communication of non-financial information by companies, issuing the so-called Corporate Sustainability Reporting Directive (CSRD). The CSRD has significantly broadened the

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[6] In the document "Strategy for Sustainable Finance", the Commission notes that "to achieve the goal of reducing emissions by 2030, Europe will need additional investments of over 300 billion euros per year in the current decade for energy systems alone, in addition to approximately 140 billion euros to be allocated to other environmental objectives".

[7] Public interest entities include companies governed by the law of a Member State with securities admitted to trading on a regulated market in a Member State; credit institutions as defined in Article 4(1) of Directive 2006/48/EC; insurance companies.

[8] The NFRD entrusted the European Commission with the task of issuing "non-binding guidelines on the methodology for the communication of non-financial information, including general and sectoral key performance indicators, in order to facilitate the relevant, useful and comparable disclosure of non-financial information by companies" (art. 2 NFRD).
The Methodology for the disclosure of non-financial information is available at www.eur-lex.europa.eu

subjective scope of application of the NFRD, limiting it only to large listed companies. The application of the NFRD has proved to be deficient, especially with regard to the harmonization of corporate communications, leading to an evolution of this discipline through the Corporate Sustainability Reporting Directive (CSRD). The CSRD represents a paradigm shift, as it includes the elaboration of sustainability reporting, abandoning imprecise non-financial declarations. The CSRD has broadened the subjective scope of application of the regulation, which is applicable, regardless of the type of activity carried out, to both large companies and SMEs authorized to operate in a regulated market in the EU, with the exception of micro-enterprises. Formally, there is provision for the publication, from an inside-out perspective, of the data necessary to understand the company's impact on sustainability issues ("materiality of impact"), as well as, from an outside-in perspective, of additional information to understand how and to what extent sustainability issues influence the company's performance and its results ("financial materiality"). In recent decades, the increase in global temperatures, the increase in natural phenomena and the negative implications for ecosystems and people's health have required a paradigm shift from the traditional model of economic growth, i.e. a sustainable management of the transformation of society's economic system. In this regard, the resilient development model is based on the integration of environmental, social and governance (ESG) factors within market dynamics. These are metrics suitable for evaluating company structure and performance and for intervening on socio-environmental issues (Berti, 2020). Within the new prospective scenario, banking and financial supervision is called upon to evolve, balancing as much as possible the activity of supervision from the analysis of current and prospective risks, with particular attention to the evolution of corporate governance systems and their repercussions in terms of the evaluation of climate transactions (Bontempi, 2021). Within the scope of climate-related financial risks, we can identify physical risk and transition risk, according to the definitions of the European Banking Authority (EBA)[9]. Physical risk refers to the financial impact of climate change, including increasingly frequent extreme weather events and progressive climate change, as well as environmental degradation, such as air, water and soil pollution, water stress, loss of biodiversity and deforestation. Physical risks can be classified as "acute" if caused by extreme events such as droughts, floods and storms, or "chronic" if caused by gradual changes, such as rising temperatures, sea levels, water stress, biodiversity degradation, land use change, habitat destruction and resource scarcity. This risk can manifest itself directly, creating material damage or a decrease in productivity, or indirectly through subsequent events, such as the interruption of production chains. Transition risks assess the financial damage that a company could suffer, directly or indirectly, as a consequence of the process of adaptation to a low-carbon and more environmentally sustainable economy. In particular, the risk associated with the transition can be caused, in this case, by the sudden adoption of climate and environmental policies, by technological progress or by changes in market confidence and preferences. These dynamics weaken the ability of institutions' business models in the medium and long term, especially for entities whose business model is based on sectors and markets, such as banking, which are particularly sensitive to exogenous factors (Simonetti, 2022). Despite having a well-defined nature, the materialization of climate and environmental risks has an impact on the 'classic' prudential risks that have traditionally characterized the banking market. In fact, climate and environmental risks can be decisive simultaneously in different existing risk categories and subcategories; the exposure of geographical areas more vulnerable to physical risks could also be influenced, for example, by a reduction in the valuations of real estate portfolio guarantees (credit risk) due to a higher level of flood risk. In any case, climate risk management involves several elements of complexity, mainly due to the high degree of uncertainty and randomness regarding the extent of the consequences of climate change. For this reason, various regulatory instruments have been introduced to support the integration of climate risks within the banking infrastructure, which share the pursuit of a unified general objective. Therefore, given that climate change is a phenomenon that involves risks capable of radiating throughout the entire system, it is necessary to identify and regulate these risks to balance them, so that the system continues to function in accordance with the rules that govern it. To regulate this aspect in the most appropriate way possible, European regulators have taken the path of hard law (Oberthur, 2019), through regulations and directives that sometimes may not coincide with state regulatory interventions of soft law, due to the principle of horizontal subsidiarity, which provides for the enhancement of the regulatory competence closest to the interest to be regulated (Serravalle, 2019). Although this is an area where legislative responsibilities are unclear, the European Union has a leading role in promoting and strengthening the financial and environmental components. According to EU Regulation 876/2019, Capital Requirement Regulation 2 (CRR2) and EU Directive 878/2019 Capital Requirement Regulation 5 (CRD5), large listed intermediaries (banks and investment firms) are required to publish ESG requirements. In this case, banks are required to publish, among other information, the Green Asset Ratio (GAR), which aims to illustrate to the market how much banks are adapting their business strategies to the objectives of the Paris Agreement; starting from the second quarter of 2024, it is mandatory to integrate the

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[9] For further information, see: European Banking Authority, Report on ESG risk management and supervision for credit institutions and investment firms, June 2021.
Available at https://www.eba.europa.eu.

emissions of the entire value chain (the so-called Scope 3 emissions) into the emissions of the borrowing companies. With reference to prudential control procedures, following an amendment to the CRD directive, banks are required to adopt governance structures, strategies and processes suitable for evaluating internal capital requirements over a medium-long term horizon and to consider ESG risks. To monitor any risks of misalignment with the Union's climate objectives, intermediaries are required to develop transition programs, including quantitative objectives, for a period of at least 10 years. Regarding disclosure requirements, an extension of ESG disclosure obligations is planned for all intermediaries (banks and investment firms subject to prudential banking regulation) through an amendment to the CRR regulation, thus including smaller banking institutions. This is a significant incentive, as ESG disclosure requirements exceed the size of the banking company, an important distinction, especially for supervisory purposes. The reason lies in the general and abstract exposure of intermediaries to environmental risks, which is not necessarily proportional to the size of the company itself. For this reason, supervisory authorities need adequate and comparable data to conduct proper supervision. The degree and international diffusion of studies on climate change and its economic and financial implications are at the origin of the Network for Greening the Financial System (NGFS)[10], which has developed standards, guidelines and climate scenarios to promote the integration of climate and environmental factors in the activities and risk management procedures of the financial system. In the prudential sphere, the Basel Committee on Banking Supervision (BCBS) and the European Banking Authority (EBA) have taken on the task of assessing whether and to what extent the current regulatory framework is adequate to correctly capture the financial risk associated with climate change. The Basel Committee established a Task Force on Climate-related Financial Risks in 2020 to strengthen the regulation, supervision and practices of banks globally, with the aim of improving financial stability. The Task Force's activities were defined by the report "Climate-related Risk Factors and their Transmission Channels" and "Climate-related Financial Risks: Measurement Methodologies"[2]. This activity preceded the development of the Principles for Effective Management and Supervision of Climate-Related Financial Risks[11].

III. Comparative Analysis Between Green Asset Ratio (Gar) And Banking Book Taxonomy Alignment Ratio (Bbtar)

Materials And Methods

This paragraph proposes a comparative analysis between the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR) (EU Regulation 2020/852 on the taxonomy), key tools for understanding banks' sustainability metrics and their impact on credit policies. The GAR, introduced by European legislation (EU Regulation 2020/852), indicates the share of a bank's assets aligned with the European Taxonomy out of the total eligible assets. However, it has significant limitations, such as the exclusion of exposures to SMEs and other assets not subject to ESG reporting requirements (EBA, 2021)[12]. To fill these gaps, the BBTAR is a complementary metric, able to include a wider range of assets, such as loans to SMEs that meet sustainability criteria, even in the absence of reporting obligations (Brühl, 2023). In this case, the GAR is calculated by dividing the value of the assets aligned with the taxonomy (e.g., loans for renewable energy projects) by the total eligible assets, but excluding categories such as loans to SMEs. In contrast, the BBTAR expands the calculation to include such exposures, weighting them according to their contribution to sustainability. This approach allows for a more comprehensive view of the banking portfolio, strengthening the ability of banks to monitor their alignment with EU sustainability objectives (UNEP FI, 2022). The study of these metrics is key to identifying areas for improvement and promoting a more inclusive and resilient ecological transition (EBA, 2021)[13]. The data used for the analysis mainly come from official sources and reference documents relating to banking sustainability and the

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[10]The Network for Greening the Financial System (NGFS) is a group of sixty-six central banks and supervisory authorities and thirteen observers committed to sharing best practices, contributing to the development of climate and environmental risk management in the financial sector.

[11] For further information, see: Basel Committee, "Principles for effective management and supervision of climate-related financial risks", June 2022.

[12] For further information, see: EBA. Call for Advice to the European Supervisory Authorities on Key Performance Indicators and Methodology on the Disclosure of How and to What Extent the Activities of Undertakings under the NFRD Qualify as Environmentally Sustainable as Per the EU Taxonomy. Available online: https://www.eba.europa.eu/sites/default/documents/files/document_library/About%20Us/Missions%20and%20tasks/ Call%20for%20Advice/2021/CfA%20on%20KPIs%20and%20methodology%20for%20disclosures%20under%20Article%2 08%20of%20the%20Taxonomy%20Regulation/963620/Letter%20to%20EC%20- %20CfA%20Article%208%20Taxonomy%20Regulation.pdf

[13] For further information, see: EBA. The EBA acknowledges the adoption by the European Commission of the Standards on Public Disclosure by Institutions. Available online: https://www.eba.europa.eu/eba-acknowledges-adoption-european- commission-standards-institutions%E2%80%99-public-disclosures

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European Taxonomy. In particular, reference was made to EU Regulation 2020/852, which defines the criteria for identifying eligible activities aligned with the European Taxonomy. In addition, data relating to the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR) were extracted from reports published by the European Banking Authority (EBA) and the European Central Bank (ECB), which provide detailed information on sustainability metrics. For loans secured by residential real estate and SME exposures, aggregate data from industry studies and ESG reports from major Italian banks were used. Finally, to ensure the consistency and representativeness of the results, the data were supplemented with simulations based on standardized metrics, as indicated in UNEP FI (2022) documents. These references ensure that the analysis is based on reliable and internationally recognized sources.

The descriptive statistics are reported below in Table 1.0, which summarizes the key information analyzed, including total activities, eligible activities, aligned activities, and the calculated GAR.

Tab.1.0 Descriptive statistical table GAR

Category	Value	Value_in_Millions	Description
Total Assets	1000000000	1000	Total assets analyzed in the portfolio
Eligible Assets	241300000	241,3	Assets eligible under the EU Taxonomy
Aligned Residential Real Estate	13030200	13,0302	Aligned assets from residential real estate loans
Aligned Non-Financial Companies	92900500	92,9005	Aligned assets from non-financial companies
Calculated GAR	0,1059307	1,05931E-07	Green Asset Ratio (GAR) calculated

Where for:
- **Total assets** refer to the assets of the bank's entire financial portfolio, including loans, investments and other holdings. In this analysis, total assets of 1,000,000,000 euros were assumed, representing the overall size of the bank's portfolio.
- **Eligible Assets** we have *loans secured by residential properties* (these represent the largest component of eligible activities, approximately 90% of total eligible activities, however only 5.4% of these loans are EU Taxonomy-aligned), *loans to non-financial* companies subject to the Non-Financial Reporting Directive (NFRD) (these have a higher rate of alignment with the EU taxonomy, around 38.5%. 5%), *loans to SMEs* (currently excluded from the GAR, however better captured by the subsequent BBTAR analysis), investments in activities that contribute to environmental objectives (climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy (including waste prevention and recycling, pollution prevention and control, protection and restoration of biodiversity and ecosystems).
- **Aligned Residential Real Estate** *on loan* are representative of the largest component of eligible assets, representing 21.52% of 24.13% of total eligible assets (approximately 90% of eligible assets); they contribute 1.17% of 1.78% to the total Green Asset Ratio (GAR), and constitute about 66% of the GAR; the alignment rate (The share of aligned assets within eligible residential real estate loans is relatively low, at 5.4%, compared to 38.5% for non-financial companies subject to NFRD. They are highlighted as a potential 'lever' to improve the overall ATR of banks, thanks to their significant share in eligible assets, despite their modest alignment rate.
- **Aligned non-financial companies**: this includes all exposures to non-financial companies that publish a Non-Financial Statement (NFS), weighted according to the share of their turnover aligned with the EU Taxonomy. These exposures are classified as part of the "general purpose" component of the GAR. The alignment rate for non-financial companies subject to the Non-Financial Reporting Directive (NFRD) is approximately **38.5%**, which is significantly higher than the alignment rate for residential real estate loans (5.4%).

Table 2.0 will show the descriptive statistics of the eligible and aligned activities analyzed for the BBTAR.

Tab. 2.0 BBTAR descriptive statistical table

Eligible_Mean	Eligible_Median	Eligible_SD	Eligible_Min	Eligible_Max	Eligible_Range	Aligned_Mean	Aligned_Median	Aligned_SD	Aligned_Min	Aligned_Max	Aligned_Range
60	65	216.025	30	80	50	42.5	45	170.783	20	60	40

Where for:
- **Eligible_Mean** corresponds to the average percentage of eligible assets in all categories analyzed for the BBTAR (60%). This metric provides a central tendency, showing the typical proportion of eligible assets in the banking portfolio.
- **Eligible_Median** indicates the median percentage of eligible assets in all categories. This is the intermediate value between the eligible percentages (65%). This figure indicates that half of the eligible percentages are lower than this value and half are higher.

- **Eligible_SD** shows the standard deviation of eligible assets, calculated as 21.60%. This measures the variability of eligible asset percentages between categories. A higher value indicates significant differences between categories, such as residential real estate (80%) and other assets (30%).
- **Eligible_Min** is **the** minimum percentage of eligible assets, equal to 30%, which represents the lowest percentage of eligible assets in any category, particularly in "Other assets".
- **Eligible_Max** defines the maximum percentage of eligible assets, equal to 80%, which represents the highest percentage of eligible assets, found in "Residential Real Estate".
- **Eligible_Range** is the range of eligible assets, calculated as 50% (80% - 30%). It shows the spread between the highest and lowest eligible percentages, highlighting the disparity between categories.
- **Aligned_Mean** is the average percentage of aligned assets, calculated as 42.5% and indicates the typical percentage of aligned assets in all categories, which is below the eligible average due to stricter alignment criteria.
- **Aligned_Median** expresses the median percentage of aligned assets, which is equal to 45% and represents the average value of the aligned percentages when they are ordered, showing that half of the categories have alignment percentages lower than 45% and half have higher percentages.
- **Aligned_SD** is the standard deviation of the aligned activities, calculated as 17.08% and measures the variability of the aligned percentages, showing moderate differences between the categories.
- **Aligned_Min** indicates the minimum percentage of aligned activities, which is equal to 20% and represents the lowest alignment percentage, found in "Other resources".
- **Aligned_Max corresponds to the** maximum percentage of aligned activities, which is 60% and is present in "Residential Properties".
- **Aligned_Range** is **the** range of aligned assets, calculated as 40% (60% - 20%). It shows **the "**scissors" between the highest and lowest alignment percentages, reflecting the variability of alignment between categories.

Suitable activities show a wider range (50%) than aligned activities (40%), indicating greater variability in suitability. Residential properties consistently have the highest percentages for both suitable and aligned activities, while other types of activities have the lowest percentages. The standard deviations (21.60% for eligible activities and 17.08% for aligned activities) emphasize the differences in variability between the two metrics. After summarizing the key descriptive statistics for eligible and aligned activities, I will proceed to a comparative analysis between the two metrics to evaluate the differences and relationships between the categories of activities.

Results

The analysis of the Green Asset Ratio (GAR) and the Banking Book Taxonomy Align Ratio (BBTAR) highlights the alignment of a bank's financial assets with the EU taxonomy for sustainable finance. These metrics aim to assess the percentage of a bank's assets that contribute to environmental objectives, such as climate change mitigation and adaptation, and to provide transparency on the bank's commitment to financing sustainable economic activities. The GAR (Eq. 1) focuses on currently eligible and aligned activities, while the BBTAR (Eq. 3) broadens the scope to include small and medium-sized enterprises (SMEs), addressing the limitations of the GAR and offering a more comprehensive view of sustainability alignment.

$$GAR = \frac{\text{Aligned Residential Real Estate} + \text{Aligned Non-Financial Companies}}{\text{Total Assets}} \tag{1}$$

$$GAR = \frac{13{,}030{,}200 + 92{,}900{,}500}{1{,}000{,}000{,}000} = 0.1059 \ (10.59\%) \tag{2}$$

Note that the GAR measures the percentage of total assets aligned with the EU taxonomy (Berrou et al., 2019). In this case, the aligned activities (residential properties and non-financial companies) are divided by the total assets of 1 billion euros, obtaining a GAR (Eq. 2) of 10.59%. This figure communicates that 10.59% of the bank's total assets are aligned with the EU taxonomy for sustainable economic activities. This reflects the percentage of the bank's portfolio dedicated to financing environmentally sustainable projects, highlighting its commitment to sustainability. This is a relatively high figure compared to the average ATR of 1.78% reported in the document for the top 10 Italian banks. It reflects a strong commitment to financing environmentally sustainable activities, such as renewable energy projects, green building initiatives or other taxonomy-aligned investments, and ensures compliance with European regulations, such as the Sustainable Finance Disclosure Regulation (SFDR) and the Corporate Sustainability Reporting Directive (CSRD), which require transparency in sustainability reporting. A GAR of this magnitude improves the bank's reputation among investors and stakeholders, positioning it as a leader in sustainable finance and potentially attracting more green investments. In summary, a GAR of 10.59% would highlight the bank's significant progress in aligning its portfolio with sustainability goals, far exceeding the industry average and setting a benchmark for other institutions.

Expanding the scope to include SMEs, the Banking Book Taxonomy Align Ratio (BBTAR) metric was used:

$$BBTAR = \frac{\text{Aligned Residential Real Estate} + \text{Aligned Non-Financial Companies}}{\text{Eligible Assets}} \quad (3)$$

$$BBTAR = \frac{13{,}030{,}200 + 92{,}900{,}500}{241{,}300{,}000} = 0.439\,(43.9\%) \quad (4)$$

The result of the calculation shows a BBTAR (Eq. 4) of 43.9%. This means that 43.9% of the total exposures of the bank's portfolio (1 billion euros), equal to 439 million euros, are in line with the EU taxonomy for sustainable activities. This indicates that almost half of the bank's loan portfolio is used to finance economic activities that meet the strict sustainability criteria of the EU taxonomy. This reflects a significant commitment to supporting the transition to a sustainable economy. Unlike the Green Asset Ratio (GAR), which excludes exposures to non-PIN companies, the BBTAR includes taxonomy-aligned exposures to small and medium-sized enterprises (SMEs) and other non-PIN entities. This makes the 43.9% figure more representative of the bank's overall sustainability efforts. A high BBTAR improves the bank's reputation with regulators, investors and stakeholders, demonstrating its leadership in sustainable finance. It also demonstrates compliance with upcoming EU regulations, such as the Corporate Sustainability Reporting Directive (CSRD). The BBTAR highlights areas where the bank can further increase alignment, for example by expanding taxonomy-aligned lending to SMEs or other underrepresented sectors. In summary, a BBTAR of 43.9% reflects a strong alignment with sustainability objectives, demonstrating the bank's proactive role in financing the green transition and its ability to seize a wider range of sustainable activities compared to the GAR.

IV.   Conclusions

The Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BBTAR) are two key metrics for assessing the alignment of financial institutions with the EU Taxonomy for sustainable finance. Although both metrics aim to measure banks' contribution to environmental objectives, their scope and efficiency differ significantly. The GAR, as a regulatory metric, provides a standardized and transparent measure of the percentage of a bank's assets aligned with sustainable activities. Its strength is reliability, as it focuses on exposures to companies that publish non-financial information (NFI), ensuring data accuracy and comparability across institutions. However, its narrow scope excludes non-NFRD companies, such as small and medium-sized enterprises (SMEs), which are key drivers of the green transition. This limitation can lead to an underestimation of a bank's real sustainability efforts, particularly in regions or sectors dominated by SMEs. In contrast, the BBTAR offers a broader and more inclusive perspective, incorporating exposures to companies outside the NFRD sector. This makes it a more representative metric for assessing a bank's overall contribution to sustainability. The use of models such as the Calibrated Taxonomy Alignment Coefficient (C-TAC) allows for an estimation of taxonomy alignment for entities that do not have direct information, enabling the inclusion of SMEs and other underrepresented sectors. However, this broader scope introduces complexity and potential subjectivity, as reliance on estimated alignment can reduce the comparability and accuracy of the metric. In addition, calculating BBTAR requires more extensive data and modeling, which can be challenging for smaller banks with limited resources. In evaluating the efficiency of these metrics, it is clear that GAR excels in regulatory compliance and comparability, while BBTAR provides a more comprehensive and nuanced view of sustainability alignment. To maximize their effectiveness, the banking system should adopt a two-pronged approach, using GAR for regulatory reporting and BBTAR for internal assessments and strategic planning. This would enable banks to meet regulatory requirements while capturing the full scope of their sustainability efforts. In addition, the banking system should invest in improving data collection and modeling capabilities to increase the accuracy and reliability of BBTAR calculations. In this way, banks can better demonstrate their commitment to sustainable finance and support the transition to a greener economy.

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